4.2. WATER QUALITY ASSESSMENT

Management Measure for Water Quality Assessment:

Assess water quality as part of marina siting and design.

Management Measure Description

Water quality assessments are generally done as a part of marina development or significant expansion. The widespread use and proven effectiveness of water quality assessments in determining the suitability of a location for marina development, the best marina design for ensuring good water quality, and the causes and sources of water quality problems make this management measure broadly applicable to marina management.

When planning for a new or expanded marina site, state water quality management agencies can be contacted for available information. A water quality assessment consists of taking samples of water from a waterbody, testing them for chemical and/or physical characteristics and the presence of pathogenic organisms, and comparing the results to accepted standards of water quality. Historically, state water quality assessments have focused on testing the dissolved oxygen concentration of water and the presence of pathogen indicators, such as fecal coliform bacteria (*Escherichia coli*) and enterococci. Other tests, such as measurement of water temperature or Secchi disk depth (Figure 4.3), are used as well.

The dissolved oxygen concentration in water is used as an indicator of the general health of an aquatic ecosystem. A good concentration of dissolved oxygen (typically about 6 milligrams/liter, but "good" can vary from waterbody to waterbody) can indicate that there's enough oxygen for fish to breathe and aquatic plants to photosynthesize, and there's a good exchange of gases between the waterbody and the atmosphere. A low dissolved oxygen concentration might indicate an unbalanced ecosystem, with fish mortality, too much decaying organic matter in the water, a film of oil or other substance on the surface that is preventing an exchange of gases with the atmosphere, aquatic plants that are unable to photosynthesize, or an absence of aquatic plants.

Pathogenic organisms in the water indicate the potential for public health problems. Pathogens are contained in human and animal fecal waste, and they can cause illness if contaminated water from the waterbody is swallowed, contaminated shellfish from the waterbody are eaten, or an open wound is exposed to the water. Tests for these

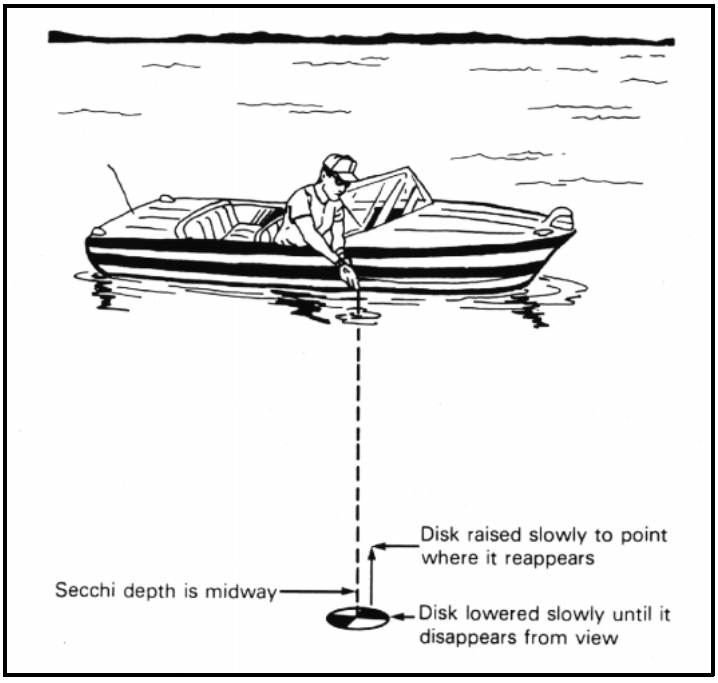

Figure 4.3. The Secchi disk is a simple and useful tool for monitoring long-term trends in water quality.

water quality criteria can be used to determine whether a proposed marina design will result in poor water quality. Water from a site proposed for marina development should be of good quality.

Federal, state, and municipal agencies routinely test the water of coastal and estuarine waters, lakes, and reservoirs, especially if there is a lot of recreational use of the waterbody and protection of public health is important. Results of the tests can be obtained by calling the agency that does the testing (e.g., state department of natural resources or environmental protection).

Best Management Practices

Monitoring can serve many purposes, such as determining the ambient quality of water, determining the extent or causes and sources of a water quality problem, analyzing trends in water quality, and measuring the effectiveness of management practices used in the marina. Modeling is appropriate for comparing the effects of different options, such as predicting the water quality that would result from different marina designs before actual construction or the effects of various slip arrangements on water circulation in a marina basin before a planned expansion. In areas of known good water quality, monitoring may not be needed for small marina developments. The BMPs described below are useful for major developments or expansions so that sufficient water quality measurements are made at a site to ensure that existing conditions are not significantly altered.

- *Use water quality sampling and/or monitoring to measure water quality conditions.*

Water quality data for the waterbody on which a marina is located might be available. Many states or local agencies collect this information. A state agency of environmental protection, a local or regional water quality authority, a parks and recreation department, the U.S. EPA, the U.S. Geological Survey, the U.S. Army Corps of Engineers, or a local university (such as Sea Grant colleges) are potential sources of water quality data.

It will be useful to contact the state agency responsible for water quality data at the outset of a project to establish water quality objectives and to determine whether water quality data is available for the site. Comparing water quality data from the marina to water quality data collected by a state agency, for instance, would be best accomplished by using the same sampling strategy and analytical methods used by the state agency so that a comparison of the two sets of data will be meaningful (Figure 4.4).

- *Use a water quality modeling methodology to predict postconstruction water quality conditions.*

Not all marinas need to use modeling techniques to predict water quality characteristics. Numerical modeling can be useful, however, for studying the effects of different design alternatives and for selecting the design that best avoids or minimizes impacts on water quality.

Figure 4.4. Cedar Island Marina scallop monitoring. After the State of Connecticut declined a permit for expansion on the grounds that it would result in "destroying valuable marina life and habitat," the marina began a program of water quality monitoring to prove the state wrong. The marina monitors temperature, salinity, dissolved oxygen, habitat, coastal birds, finfish, and scallop growth. The figure above shows marina personnel checking scallop cages suspended below the docks. The marina has found better dissolved oxygen levels and lower fecal coliform counts than reported for the town beach, and heavy metals do not accumulate in scallops grown at the marina (EPA, 1996: *Clean Marinas—Clear Value).*

Modeling techniques can be useful for predicting flushing time and pollutant concentrations in the absence of site-specific data. A distinct advantage of numerical models over monitoring studies is the ability to perform sensitivity analyses. For instance, dissolved oxygen concentrations and flushing times can be predicted for a number of design options once data for the marina project have been entered into the model. Modeling can be an expensive undertaking, and this should be weighed against any anticipated benefits.

EPA Region 4 completed an in-depth report on marina water quality. The primary focus of the study was to provide guidance for selecting and applying of computer models for analyzing the potential water quality impacts (both dissolved oxygen and pathogen indicators) of a marina. EPA reviewed a number of available methods and classified them into three categories—simple methods, mid-range models, and complex models.

A professional marina designer would be the best person to consult regarding the feasibility and cost of using models. Some models applicable to marinas are reviewed in Section 5.

- *Monitor water quality using indicators.*

Water sampling, water quality monitoring, and numerical modeling are not necessary in many cases to gather information about the health of a marina's waters. Simple yet effective forms of monitoring that provide valuable information about the conditions in the water can be done by someone knowledgeable of the marina and the surrounding waterbody. Visual inspections of the abundance and appearance of aquatic plants in and around the marina, use of the marina and surroundings by ducks and geese, the appearance of bottom sediments, the general clarity of the water near docks, and the abundance of fish can provide all the information necessary to judge the health of the water (Figure 4.5). All of these characteristics are indicators of the health of the waters. These types of inspections can be done during the course of daily operations by any member of the marina staff at minimal cost to the marina (see volunteer monitoring BMP below). Done every year, these visual inspections lead to a good knowledge of the "normal" conditions in the marina and surrounding waterbody, and any changes will be apparent to the keen observer. When changes are noted, some limited water sampling can be done to determine what might account for them if a local or state environmental management authority hasn't already done this.

- *Use rapid bioassessment techniques to monitor water quality.*

Rapid bioassessment techniques can provide a cost-effective assessment of potential sites for marina development and to assess water quality in an existing marina basin. This technique is discussed further under the Habitat Assessment management measure.

- *Establish a volunteer monitoring program.*

Marinas can help involve their clientele and local community in water quality issues and environmental protection at the marina by beginning a volunteer monitoring program. Across the country, private citizens are learning about water quality issues and helping protect the Nation's water resources by becoming volunteer monitors. Volunteers analyze water samples for dissolved oxygen, nutrients, pH, temperature, and a host of other water constituents; evaluate the health of stream habitats and aquatic biological communities; inventory stream-side conditions and land uses within a watershed that might affect water quality; catalog and collect beach debris, and restore degraded habitats.

EPA's Office of Water encourages citizens to learn about their water resources and supports volunteer monitoring because of its many benefits. Volunteer monitors build awareness of pollution problems, become trained it pollution prevention, help clean up problem sites, provide data for waters that may otherwise be unassessed, and increase the amount of water quality information

available. Among the uses of volunteer data are delineating and characterizing watersheds,

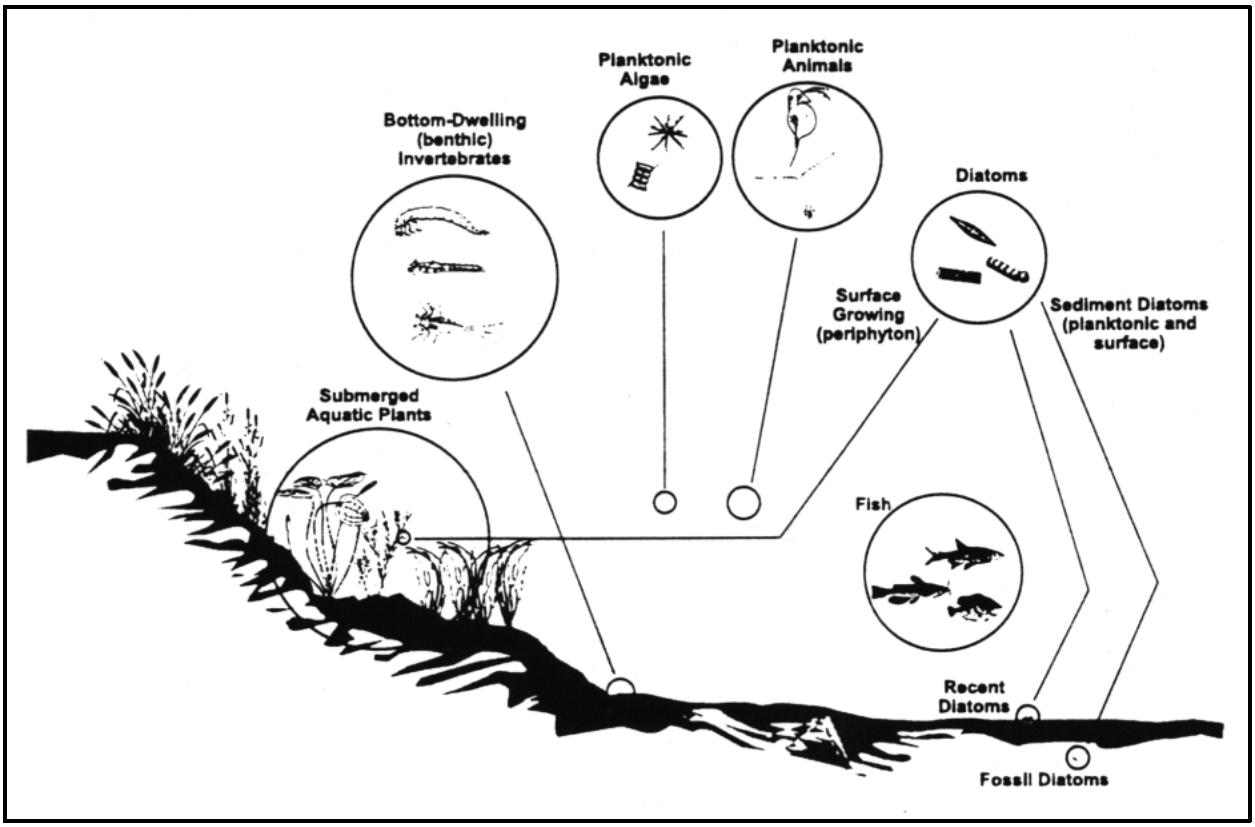

Figure 4.5. Biological assemblages used for lake monitoring.

screening for water quality problems, and measuring baseline conditions and trends.

For more information, contact EPA's Office of Wetlands, Oceans, and Watersheds, Monitoring Branch, or the monitoring branch of a regional EPA or state environmental protection office. EPA's volunteer monitoring Web site is located at <www.epa.gov/owow/monitoring/vol.html>.

BMP Summary Table 2 summarizes the BMPs for Water Quality Assessment mentioned in this guidance.

BMP Summary Table 2. MANAGEMENT MEASURE FOR WATER QUALITY ASSESSMENT

MANAGEMENT MEASURE: Assess water quality as part of marina siting and design.

ENVIRONMENTAL CONCERNS:

Water quality is assessed during the marina design phase to predict the effect of marina development on the chemical and physical health of the water and aquatic environment. Marina development can cause changes in flushing and circulation; and boat maintenance, boat operation, and the human activities in and around boats can be sources of solid and liquid wastes, pathogenic organisms, and petroleum compounds. The results of water quality predictions or sampling are compared to state or federal water quality standards. Water quality assessments for dissolved oxygen concentration and pathogenic organisms can be used as indicators of the general health of an aquatic environment. Water quality assessments can be useful in determining the suitability of a location for marina development, the best marina design for ensuring good water quality, and the causes and sources of water quality problems.

WATER QUALITY ASSESSMENT PRACTICES

Best Management Practice Examples & Type	Marina Location & Usage	Benefits to Marina	Projected Environmental Benefits	Initial Cost Estimate	Annual Operation & Maintenance Cost Estimate	Notes
Use water quality sampling and/or monitoring to measure water quality conditions	Proposed marina basin/expansion site; generally recommended	MODERATE; can help determine whether a proposed marina will negatively affect water quality and suggest design alternatives; might be required	MODERATE to HIGH; can help determine if an area can sustain good water quality with a marina	HIGH, depends on type of tests and number or samples	None	Testing the water for general characteristics such as dissolved oxygen and clarity might be all that is necessary to determine whether proposed area can support a marina; gather existing data first.
Use a water quality modeling methodology to predict post-construction water quality conditions	Proposed marina basin; recommended for large new projects	LOW to MODERATE; computer modeling can cost less than sampling; can help choose the best design; suitable for predicting circulation and wave damage exposure	MODERATE to HIGH; models can predict flushing and pollutant loads for many different marina designs	MODERATE to HIGH	None	Some models applicable to marinas are reviewed in Section 5.
Monitor water quality using indicators	Marina grounds and basin; universally recommended	HIGH to MODERATE; quickly provides information about the health of the water and aquatic habitat	HIGH; regular visual inspections help track changes, help identify potential problems before they become large	None	LOW to NONE	Inspect for appearance, clarity, and smell of water, abundance and appearance of aquatic plants, use by aquatic animals, appearance of sediments, visible pollutants and litter; very cost effective, simple,

BMP Summary Table 2. (cont.) MANAGEMENT MEASURE FOR WATER QUALITY ASSESSMENT						
Best Management Practice Examples & Type	**Marina Location & Usage**	**Benefits to Marina**	**Projected Environmental Benefits**	**Initial Cost Estimate**	**Annual Operation & Maintenance Cost Estimate**	**Notes**
Use rapid bioassessment techniques to monitor water quality	Marina basin; recommended where bioassessment protocols have been established	HIGH to MODERATE; provides information about the biological quality of marina waters.	MODERATE; can indicate water quality problems that might not be tested for in a water quality sampling program.	LOW; might have to train someone in aquatic invertebrate identification.	LOW	Provides a cost-effective assessment of water quality and an integrated assessment of the biological suitability of marina water quality.
Establish a volunteer monitoring program	Marina grounds and basin; universally recommended	HIGH to MODERATE; provides information about all aspects of the marina; actively involves marina patrons	MODERATE to HIGH; volunteers focus on different environmental issues and develop keen environmental awareness and concern	LOW; some basic equipment and training for volunteers will be necessary	LOW	Volunteers can monitor dissolved oxygen, nutrients, pH, temperature, and other water quality constituents; and environmental conditions in hull maintenance areas, recycling stations, on docks, etc.